Inverse Weibull Method Application to wind Speed Modeling in Campo Grande-Ms Brazil

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Abstract: Wind potential estimation requires an analysis of wind characteristics (wind speed density and wind direction). In this study, the applicability of two distribution models named Weibull and Inverse Weibull aiming to characterize the wind speed distribution in Campo Grande-Ms (Brazil) is investigated. The wind speed data collected from Campo Grande-Ms National Institute of Meteorology (INMET) at 10 m height for 5 years from January 2013 to December 2017, at an hour interval, are used. The method of maximum likelihood estimation is applied to calculate the parameters of the selected distributions. The best distribution function is chosen based on three goodness-of-fit statistics, namely; mean absolute percentage error (MAPE), root mean square error (RMSE), and coefficient of determination (R²). The obtained results indicate that the Weibull distribution provides a more accurate and efficient estimation than Inverse Weibull distribution. Therefore, Weibull distribution can be used to better estimate wind speed distribution in Campo Grande-Ms (Brazil) than Inverse Weibull distribution.

Keywords: Wind speed, Weibull distribution, Inverse Weibull distribution.

1. INTRODUCTION

Electricity is an indispensable factor for the economic development of all countries in the world. Its relative importance increases with technological progress, industrialization, and the need for modern comfort. Renewable electricity comes from six energy sources, namely: geothermal, wind, solar, hydroelectric, biomass and marine [1]. Wind energy is one of the most efficient sources of renewable energies available. In 2016, China was the largest producer of electricity from the wind with 237.07 TWh (which constitutes 24.7% of world production), followed by the United States with 229.47 TWh (24% of the world production), then, Germany with 78.6 TWh i.e., 8.2% of world production [2].

For a given region, the wind potential estimation requires an analysis of wind characteristics (wind speed density and wind direction). They can have considerable differences between regions, even at short distances. Characterization of wind speed is complex because of the random nature of its variation. It does not follow any known statistical distribution. This is why several probability distribution functions exist in the literature, namely; Weibull distribution [3-10], Gamma distribution [3, 5, 10], Rayleigh distribution [4-6, 10], Normal distribution [6, 10], Lognormal [3, 5, 6, 10], Inverse Gaussian [6, 10], Logistic [6, 10], Generalized Extreme Values [6, 10], Nakagami [6, 10], Log-normal [6, 10], Log-logistic [6, 10], Birnbaum-Saunders distribution [6, 10]……

The quality of the adjustment of the distribution used depends on the estimation method and the region studied. The Weibull and Rayleigh distributions are the most common ones used by researchers to model wind speed data. The Weibull distribution has mostly been used to fit wind speed variation for wind energy applications. Weibull parameters are obtained using different estimation methods [6, 9, 11], namely; maximum likelihood, Modified maximum likelihood, Graphical method, Last squares method, moment method, Energy pattern factor method, Empirical method of Justus, and Empirical method of Lysen.

Recently, an alternative to the Weibull distribution is used, named as Weibull inverse distribution. Gül Akgül \textit{et al.} [12] compared the applicability of these two distributions to two different regions in Turkey, Bursa, and Sakarya, using three parameter estimators (maximum likelihood, maximum likelihood modified and last squares). The results found showed that the inverse Weibull distribution provides a better wind estimation than Weibull distribution. In addition, Emrah Dokur \textit{et al.} [13] have applied those two methods to Bilecik, another region in the same country, using maximum likelihood Weibull parameter estimator. They
have noted the best fit of the alternative distribution to model Bilecik wind speed distribution.

This paper aims to check the applicability of the Inverse Weibull distribution (IWD) in modeling wind speed in Campo Grande-Ms Brazil. This research document is organized as follows: in section 2, first, the wind speed distributions and the maximum likelihood estimator used to estimate their parameters are presented. Then, the data used in this study are reported. Finally, the goodness-of-fit tests are given in order to compare the two selected distributions (WD and IWD). In section 3, the results and discussion are presented. A conclusion of this work is given in section 4.

2. MATERIALS AND METHODS

2.1. Modeling Methods For Estimating Wind Speed

In this study, two distributions are used to model the wind speed in Campo Grande region located in Brazil, namely; the Weibull distribution (WD) and the inverse Weibull distribution (IWD).

2.1.1. Weibull Distribution

Weibull distribution (W) is a probability distribution function, which is usually used for describing wind speed and evaluating wind energy. In this study, we use the two-parameter probability distribution function given as follows: [5, 7, 8-10]

\[
f_W(v) = \left(\frac{k}{c}\right)^{-1} \exp\left[-\left(\frac{v}{c}\right)^k\right] \quad (k>0, c>0, v>0)
\] (1.a)

Where v, k, and c are wind speed (m/s), shape factor (dimensionless), and scale factor (m/s) respectively.

The cumulative function of Weibull distribution can be obtained by the integral of the probability distribution function. It is given as [5,7]:

\[
F_W(v, k, c) = 1 - \exp\left[-\left(\frac{v}{c}\right)^k\right] \quad (k>0, c>0, v>0)
\] (1.b)

2.1.2 Inverse Weibull Distribution

The inverse Weibull distribution (IWD) has gained recently more interest in the research field. It is obtained by changing the variable (v) in Weibull distribution by its inverse (1/v). The shape and scale parameters (k, c) of the inverse Weibull distribution (IWD) are given as follows [10, 12, 13]:

\[
f_{IW}(v) = \left(\frac{k}{c}\right)^{-1} \exp\left[-\left(\frac{v}{c}\right)^{-k}\right] \quad (k>0, c>0, v>0)
\] (2.a)

The cumulative function of the Inverse Weibull distribution has the following form [12, 13]:

\[
F_{IW}(v, k, c) = \exp\left[-\left(\frac{v}{c}\right)^{-k}\right] \quad (k>0, c>0, v>0)
\] (2.b)

There are several methods to estimate the k and c parameters of the two distributions (W and IWD) namely; Maximum Likelihood Method (MLM), Modified Maximum Likelihood Method (MMLM), Moment Method (MM), Power Density Method (PDM), Graphical Method (GM), and empirical method. During this study, the Maximum Likelihood Method (MLM) is applied.

2.1.3. Maximum Likelihood Estimator

The Likelihood function for the Weibull (W) distribution is given as follows:

\[
L(k, c) = \prod_{i=1}^{n} f_W(v_i, k, c)
\] (3.a)

\[
L(k, c) = \prod_{i=1}^{n} \left(\frac{k}{c}\right)^{-1} \exp\left[-\left(\frac{v_i}{c}\right)^k\right] \quad (3.b)
\]

The log-likelihood function is given by:

\[
\ln(L(k, c)) = n \ln k - nk \ln c - (k-1)\ln(v_i) - c^{-k} \sum_{i=1}^{n} v_i^{-k}
\] (4)

The log-likelihood function is maximized by taking the derivatives of \(\ln(L(k, c))\) relative to the parameters k and c equal to zero, the obtained equations are given as:

\[
\frac{\partial \ln(L(k, c))}{\partial k} = \frac{n}{k} - \sum_{i=1}^{n} \ln(v_i) + c^{-k} \sum_{i=1}^{n} (\ln(v_i))v_i^{-k} = 0
\] (5.a)

\[
\frac{\partial \ln(L(k, c))}{\partial c} = -\frac{nk}{c} + kc^{-k-1} \sum_{i=1}^{n} v_i^{-k} = 0
\] (5.b)

The same method applies to the Inverse Weibull distribution case. The following equations are obtained:

\[
L(k, c) = \prod_{i=1}^{n} f_{IW}(v_i, k, c)
\] (6)

\[
\ln(L(k, c)) = n \ln k + nk \ln c - (k+1)\ln(v_i) + c^k \sum_{i=1}^{n} v_i^{-k}
\] (7)
\[
\frac{\partial \ln(L(k,c))}{\partial k} = \frac{n}{k} - \sum_{i=1}^{n} \ln(v_i) + c^k \sum_{i=1}^{n} v_i^{-k} \ln v_i = 0 \quad (8.a)
\]
\[
\frac{\partial \ln(L(k,c))}{\partial c} = \frac{n}{c} - k c^k \sum_{i=1}^{n} v_i^{-k} = 0 \quad (8.b)
\]

The solutions of these likelihood equations (5a, 5b) for Weibull distribution and the Inverse Weibull distribution (8a, 8b) are obtained by an iterative method using Newton-Raphson iteration method.

2.2. Case Study

In order to check the capability of the Weibull distribution and the inverse Weibull distribution to describe the wind speed distribution, Campo Grande-Ms province has been used as a case of study. Campo Grande is the capital of the Brazilian state of Mato Grosso do Sul. It is the largest city of the Center-West region of Brazil (Figure 1). This region is located in a plateau region in the center of the state, with a plain landscape covering around 8,096 km². In addition, 33.4% of its area is urbanized, with less than 1% of the municipal area are under conservation units [14]. Campo Grande-Ms is located at latitude of 20°26'34'' South and longitude of 54° 38' 47'' West. This province is at an altitude of 532 m above sea level. Its climate is equatorial with two well-defined seasons, a dry winter (from April to August) and a wet summer (from September to March).

The hourly wind speed data considered in this study are taken from Campo Grande-Ms National Institute of Meteorology (INMET) at 10 m height from January 2013 to December 2017 (data recorded for five years).

2.3. Goodness of fit and Data Used

In order to compare the two selected distributions seen above in terms of the fitting ability of wind speed data, several goodness-of-fit tests have been used in the literature to analyse wind speed. Indeed, the most widely used tests are the mean absolute percentage error (MAPE), the root mean square error (RMSE), and the coefficient of determination ($R^2$). These latter are used in this investigation and detailed in the following.

2.3.1. Mean Absolute Error (MAPE)

The mean absolute percentage error is applied to test the predicted distribution of observed climatic variables (wind speed in this case) against the real distribution. Often, it is defined as the mean of the absolute errors derived from the observed and predicted values, mathematically expressed as [11]:

\[
MAPE = \frac{1}{N} \sum_{i=1}^{N} \left| \frac{f_i - f_{mi}}{f_{mi}} \right| 
\]  

Where $f_{mi}$ are the frequency observed or measured values of wind speed; $f_i$ is the predicted frequency values through Weibull distribution (or Weibull inverse distribution). $N$ is the number of wind speed observations.

2.3.2. Root Mean Square Error (RMSE)

The root mean square error identifies the precision of the model by providing a term by term comparison between observed frequency probabilities and predicted frequency probabilities. It is given by the following formula [8, 10, 11]:

\[
RMSE = \left( \frac{1}{N} \sum_{i=1}^{N} (f_i - f_{mi})^2 \right)^{1/2} 
\]

2.3.3. Coefficient of Determination ($R^2$)

The coefficient of determination ($R^2$) indicates the proportional magnitude of variation in the predicted wind speed (WD or WID) relative to the measured wind speed using a linear regression model. It can be calculated as follows [8,10,11]:

\[
R^2 = 1 - \frac{\sum_{i=1}^{N} (f_{mi} - f_i)^2}{\sum_{i=1}^{N} (f_{mi} - \bar{f}_m)^2} 
\]

Where $\bar{f}_m$ is the mean frequency of the measured values.
3. RESULTS AND DISCUSSION

The knowledge of the average annual wind speed of a given site makes it possible to determine the importance of the wind energy at this site. The monthly and maximum monthly wind speeds inform us about seasonal and inter-annual wind speed variations. Average annual and monthly speeds are also used to estimate annual and monthly usable wind power. Moreover, the maximum wind speeds allow us to know the critical speed and subsequently to predict the resistance of the rotor, which is the main part of the wind generator. They are also important for the development of automatic controls that preserve the wind turbine when the wind speed reaches its critical value.

Table 1 described the monthly and annual averages wind speed in Campo Grande-Ms region for five years of study, i.e.; from 2013 to 2017 for twenty-four measurements per day. The maximum monthly average wind speed in this region was observed to be 4.09 m/s in July 2017, while the minimum value (2.27 m/s) was recorded in December 2017 (see Table 1). On the other hand, the year and the month during which the wind was stable are the year 2016 and August month respectively (lower standard deviation).

As mentioned earlier, the two distributions, namely, Weibull and inverse Weibull are compared in order to determine their suitability to estimate wind speed in Campo Grande-Ms city. The empirical coefficients of these two models obtained for the monthly, seasonal, and whole years’ data are listed in Table 2a and 2b. This estimation was performed using Excel Microsoft 2010.

Table 1: Monthly and Yearly Wind Speeds in Campo Grande-MS city, Brazil (2013-2017)

<table>
<thead>
<tr>
<th>Years</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months</td>
<td>V(m/s)</td>
<td>V(m/s)</td>
<td>V(m/s)</td>
<td>V(m/s)</td>
<td>V(m/s)</td>
<td>V(m/s)</td>
<td></td>
</tr>
<tr>
<td>Jan</td>
<td>3.06</td>
<td>2.44</td>
<td>2.48</td>
<td>2.71</td>
<td>2.37</td>
<td>2.61</td>
<td>0.28</td>
</tr>
<tr>
<td>Feb</td>
<td>2.65</td>
<td>2.67</td>
<td>2.31</td>
<td>2.34</td>
<td>2.29</td>
<td>2.45</td>
<td>0.19</td>
</tr>
<tr>
<td>Mar</td>
<td>2.84</td>
<td>2.59</td>
<td>2.40</td>
<td>2.52</td>
<td>2.65</td>
<td>2.60</td>
<td>0.16</td>
</tr>
<tr>
<td>Apr</td>
<td>2.95</td>
<td>3.02</td>
<td>2.73</td>
<td>2.66</td>
<td>3.07</td>
<td>2.89</td>
<td>0.18</td>
</tr>
<tr>
<td>May</td>
<td>3.00</td>
<td>3.15</td>
<td>3.21</td>
<td>3.00</td>
<td>2.68</td>
<td>3.01</td>
<td>0.20</td>
</tr>
<tr>
<td>Jun</td>
<td>2.70</td>
<td>3.36</td>
<td>3.77</td>
<td>3.36</td>
<td>3.41</td>
<td>3.32</td>
<td>0.39</td>
</tr>
<tr>
<td>Jul</td>
<td>3.81</td>
<td>3.69</td>
<td>3.44</td>
<td>3.53</td>
<td>4.09</td>
<td>3.71</td>
<td>0.26</td>
</tr>
<tr>
<td>Aug</td>
<td>3.74</td>
<td>3.62</td>
<td>3.77</td>
<td>3.57</td>
<td>3.83</td>
<td>3.70</td>
<td>0.11</td>
</tr>
<tr>
<td>Sep</td>
<td>4.02</td>
<td>3.64</td>
<td>3.38</td>
<td>3.52</td>
<td>3.86</td>
<td>3.68</td>
<td>0.26</td>
</tr>
<tr>
<td>Oct</td>
<td>3.30</td>
<td>3.64</td>
<td>3.27</td>
<td>3.56</td>
<td>3.45</td>
<td>3.44</td>
<td>0.16</td>
</tr>
<tr>
<td>Nov</td>
<td>3.09</td>
<td>2.86</td>
<td>2.71</td>
<td>3.07</td>
<td>2.98</td>
<td>2.94</td>
<td>0.16</td>
</tr>
<tr>
<td>Dec</td>
<td>2.30</td>
<td>2.68</td>
<td>2.82</td>
<td>2.86</td>
<td>2.27</td>
<td>2.59</td>
<td>0.28</td>
</tr>
<tr>
<td>Mean</td>
<td>3.12</td>
<td>3.11</td>
<td>3.02</td>
<td>3.06</td>
<td>3.08</td>
<td>3.08</td>
<td></td>
</tr>
<tr>
<td>σ</td>
<td>0.51</td>
<td>0.46</td>
<td>0.52</td>
<td>0.44</td>
<td>0.65</td>
<td>0.48</td>
<td></td>
</tr>
</tbody>
</table>

Table 2a: Weibull and Inverse Weibull Distribution Parameters of Monthly Wind Speed in Campo Grande-MS city, Brazil (2013-2017)

<table>
<thead>
<tr>
<th>Dist</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>Mai</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>WD</td>
<td>k</td>
<td>2.391</td>
<td>2.342</td>
<td>2.546</td>
<td>2.515</td>
<td>2.431</td>
<td>2.510</td>
<td>2.860</td>
<td>2.720</td>
<td>2.593</td>
<td>2.305</td>
<td>2.457</td>
</tr>
<tr>
<td>IWD</td>
<td>k</td>
<td>1.897</td>
<td>1.931</td>
<td>1.960</td>
<td>1.963</td>
<td>1.846</td>
<td>1.877</td>
<td>2.712</td>
<td>1.855</td>
<td>1.864</td>
<td>1.857</td>
<td>1.886</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>2.175</td>
<td>2.067</td>
<td>2.269</td>
<td>2.399</td>
<td>2.439</td>
<td>2.690</td>
<td>3.314</td>
<td>3.026</td>
<td>2.945</td>
<td>2.771</td>
<td>2.429</td>
</tr>
</tbody>
</table>
Wind speed monthly evolution according to Weibull and Inverse Weibull distributions and the corresponding measured frequency histograms are shown in Figure 2. The seasonal and annual evolution of Weibull and Inverse Weibull distributions are illustrated in Figure 3.

As shown in Figures 2 and 3, the Weibull distribution is better than the Inverse Weibull distribution in all cases of study, i.e. months, seasons, and the whole year. This distribution fits well the evolution of frequency histograms (real values). This distribution fits well the evolution of frequency histograms (real values). To confirm this result, a statistical analysis was performed, and the results obtained are illustrated in Table 3.

We observe that the monthly coefficient of determination ($R^2$) for the Weibull distribution (WD) varies between 0.899 recorded in December and 0.994 recorded in February. On the other hand, in the case of the Inverse Weibull distribution (IWD), the values of $R^2$ are lower than those found for the Weibull distribution. Indeed, they fluctuate between 0.526 (observed in August) and 0.845 (observed in July). On the seasonal scale, the coefficient of determination ($R^2$) for Weibull distribution (WD) varies between 0.967 noted in the autumn season and 0.989 recorded in the winter and spring seasons. The $R^2$ coefficient varies between 0.59 (in summer) and 0.816 (autumn) and takes a value of 0.747 for the annual distribution in case of Inverse Weibull distribution (Again, lowest $R^2$ values of inverse Weibull distribution).

**Table 2b:** Weibull and Inverse Weibull Distribution Parameters of Seasonal and Annual Wind Speed in the Campo Grande-MS City, Brazil (2013-2017)

<table>
<thead>
<tr>
<th>Distribution</th>
<th>Autumn</th>
<th>Spring</th>
<th>Winter</th>
<th>Summer</th>
<th>Whole year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$k$</td>
<td>2.396</td>
<td>2.438</td>
<td>2.342</td>
<td>2.622</td>
<td>2.367</td>
</tr>
<tr>
<td>$c$</td>
<td>4.367</td>
<td>3.764</td>
<td>3.492</td>
<td>4.599</td>
<td>4.065</td>
</tr>
<tr>
<td><strong>IWD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$k$</td>
<td>1.851</td>
<td>1.906</td>
<td>1.906</td>
<td>1.875</td>
<td>1.844</td>
</tr>
<tr>
<td>$c$</td>
<td>2.700</td>
<td>2.338</td>
<td>2.138</td>
<td>2.911</td>
<td>2.490</td>
</tr>
</tbody>
</table>

**Table 3:** Statistical Analysis wind Speed in Campo Grande-MS city, Brazil (2013-2017)

<table>
<thead>
<tr>
<th>Months</th>
<th>MAPE</th>
<th>RMSE</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WD</td>
<td>IWD</td>
<td>WD</td>
</tr>
<tr>
<td><strong>Months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan</td>
<td>0.204</td>
<td>0.396</td>
<td>0.0356</td>
</tr>
<tr>
<td>Feb</td>
<td>0.141</td>
<td>0.402</td>
<td>0.0240</td>
</tr>
<tr>
<td>Mar</td>
<td>0.116</td>
<td>0.463</td>
<td>0.0240</td>
</tr>
<tr>
<td>Apr</td>
<td>0.206</td>
<td>0.387</td>
<td>0.0593</td>
</tr>
<tr>
<td>May</td>
<td>0.094</td>
<td>0.434</td>
<td>0.0183</td>
</tr>
<tr>
<td>Jun</td>
<td>0.108</td>
<td>0.387</td>
<td>0.0185</td>
</tr>
<tr>
<td>Jul</td>
<td>0.089</td>
<td>0.316</td>
<td>0.0235</td>
</tr>
<tr>
<td>Aug</td>
<td>0.139</td>
<td>0.447</td>
<td>0.0217</td>
</tr>
<tr>
<td>Sep</td>
<td>0.105</td>
<td>0.447</td>
<td>0.0207</td>
</tr>
<tr>
<td>Oct</td>
<td>0.246</td>
<td>0.360</td>
<td>0.0583</td>
</tr>
<tr>
<td>Nov</td>
<td>0.114</td>
<td>0.431</td>
<td>0.0336</td>
</tr>
<tr>
<td>Dec</td>
<td>0.162</td>
<td>0.429</td>
<td>0.0460</td>
</tr>
<tr>
<td><strong>Seasons</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aut</td>
<td>0.203</td>
<td>0.347</td>
<td>0.056</td>
</tr>
<tr>
<td>Spr</td>
<td>0.183</td>
<td>0.339</td>
<td>0.049</td>
</tr>
<tr>
<td>Win</td>
<td>0.172</td>
<td>0.458</td>
<td>0.048</td>
</tr>
<tr>
<td>Sum</td>
<td>0.077</td>
<td>0.459</td>
<td>0.017</td>
</tr>
<tr>
<td><strong>Whole year</strong></td>
<td>0.217</td>
<td>0.398</td>
<td>0.055</td>
</tr>
</tbody>
</table>


Figure 2: Monthly wind speed distributions in Campo-Grande-Ms City, Brazil (2013-2017).
The monthly root mean square error (RMSE) value of Weibull distribution varies in the interval from 0.0183 (noted in May) to 0.0593 (noted in April). In contrast, the Inverse Weibull distribution takes the highest values. Indeed, it varies between 0.052 (in July) and 0.108 (in April).

The value of the seasonal mean square error (RMSE) of the Weibull distribution varies between 0.017 (summer) and 0.056 (autumn) and that of the Weibull inverse distribution between 0.056 recorded in the autumn and 0.106 noted in the winter. For the annual mean square error value of the Weibull and inverse Weibull distributions, they take the values of 0.055 and 0.095, respectively.

The monthly mean absolute percentage error value of Weibull distribution varies between 0.049 (May) and 0.246 (October) and that of Inverse Weibull distribution between 0.316 (July) and 0.4 (August and September). In the case of seasons, the value of the mean absolute percentage error of the Weibull distribution varies between 0.077 (summer) and 0.203 (autumn) and that of the Weibull inverse distribution between 0.339 and 0.459, noted in the autumn and summer, respectively. Moreover, the annual mean absolute percentage error values of the Weibull and inverse Weibull distributions are 0.217 and 0.398, respectively.

It can be said that the values of the determination coefficient (R²) for the Weibull distribution are higher
than those of the Weibull inverse distribution of the monthly, seasonal, and whole year analysis. These values are greater than 0.967 in the case of Weibull distribution. Conversely, the inverse Weibull distribution has high values of RMSE and MAPE compared to Weibull distribution. According to these results, we can say that the distribution of Weibull is best adapted for the description of the evolution of wind speed frequency distribution in Campo Grande -Ms (Brazil).

This result is not in agreement with those found in Turkey regions, namely Barsa [12], Sakarya [12], and Bilecik [13], where Weibull Inverse distribution is the best model for the description of wind speed frequency distributions.

Therefore, we can say that the frequency distribution of the wind speed is a characteristic that depends on the region studied.

4. CONCLUSION

This study compares the adequacy of the two distributions, namely; Weibull and Inverse Weibull for the description of the wind speed frequency in the region of Campo Grande-Ms (Brazil). This investigation allowed us to retain the following points:

1. The mean value of the annual wind speed in this region is about 3.08 m/s. The mean maximum value of monthly wind speed is 3.71 m/s recorded in July and the mean minimum value of monthly wind speed is 2.45 m/s noted in February. The months of June, July, August, September, and October are the windiest months of the year,

2. The parameters of Weibull (WD) and Inverse Weibull (IWD) distributions were determined using the maximum likelihood estimator for monthly, seasonal and annual analysis. Frequency distributions evolution of the two models reveals that the Weibull distribution is the best adapted to the three cases studied (monthly, seasonal and annual),

3. This result does not agree with those of the literature (case of Turkey). Therefore, the choice of the frequency distribution strongly depends on the studied site.

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